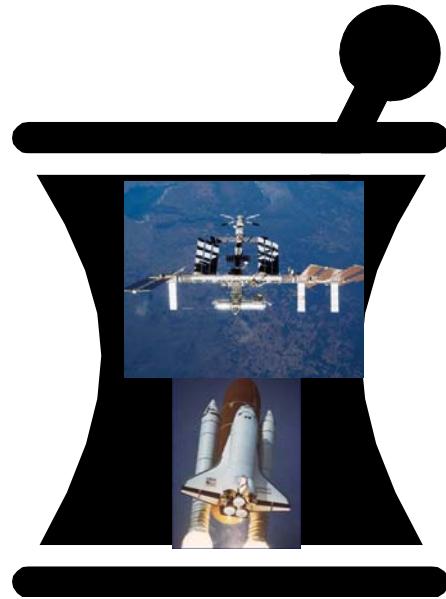


# **Pharmacy in a New Frontier – The First Five Years at the Johnson Space Center Pharmacy**



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# Abstract

- A poster entitled “Space Medicine – A New Role for Clinical Pharmacists” was presented in December 2001 highlighting an up-and-coming role for pharmacists at the Johnson Space Center (JSC) in Houston, Texas. Since that time, the operational need for the pharmacy profession has expanded with the administration’s decision to open a pharmacy on site at JSC to complement the care provided by the Flight Medicine and Occupational Medicine Clinics. The JSC Pharmacy is a hybrid of traditional retail and hospital pharmacy and is compliant with the ambulatory care standards set forth by the Joint Commission. The primary charge for the pharmacy is to provide medication management for JSC. In addition to providing ambulatory care for both clinics, the pharmacists also practice space medicine. A pharmacist had been involved in the packing of both the Space Shuttle and International Space Station Medical Kits before the JSC Pharmacy was established; however, the role of the pharmacist in packing medical kits has grown. The pharmacists are now full members of the operations team providing consultation for new drug delivery systems, regulations, and patient safety issues. As the space crews become more international, so does the drug information provided by the pharmacists. This presentation will review the journey of the JSC Pharmacy as it celebrated its five year anniversary in April of 2008. The implementation of the pharmacy, challenges to the incorporation of the pharmacy into an existing health-care system, and the current responsibilities of a pharmacist at the Johnson Space Center will be discussed.

# Learning Objectives

- Outline the implementation plan for the JSC Pharmacy.
- Describe the practice of space medicine as it pertains to pharmacy.
- Identify challenges that have been addressed in the last five years.
- Identify areas for future involvement in space medicine.

# Pharmacy Enters the US Space Program

- A position created in June 2000
  - Full time pharmacist with pharmacology lab at JSC
- Projects
  - Research
    - Promethazine study
    - Stability study
  - Drug Information
    - Monographs
  - Pack Space Shuttle and ISS medical kits



# A Second Position is Created



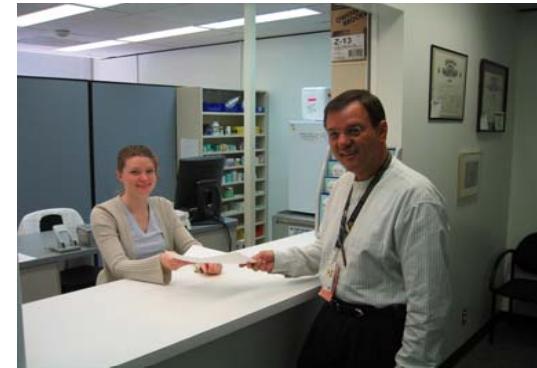
- Started part-time with the Flight Medicine Clinic in end 2001
- NASA management decision to create onsite pharmacy
- Full time with Flight Medicine Clinic mid 2002
- Design, implement a hybrid pharmacy
  - Primarily ambulatory/community
  - ‘Healthy dose’ of hospital/clinic (Joint Commission)



# Decision – Onsite Pharmacy

- Storage issues
- Patient care was not maximized to include drug-drug, drug-food or allergy interactions
- No recall system
- Control issues - access to non-medically trained individuals.
- Accountability concerns – “there one day, gone the next”

# Johnson Space Center Pharmacy



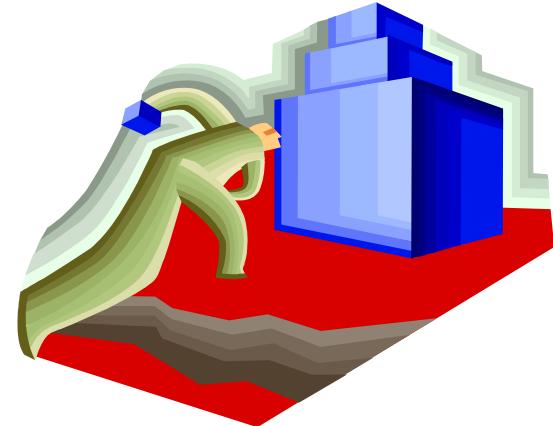
- JSC Pharmacy opened March 31, 2003
- Service to Flight Medicine and Occupational Medicine clinics
- Provides control and accountability of medications
- Provides necessary security
- Provides ambulatory care pharmacy services
- Comply with Ambulatory Joint Commission Standards

# General Challenges

- Inserting medication management into existing clinical practices
- Preconceived and misunderstood ideas of pharmacy responsibilities
- Well-established behaviors

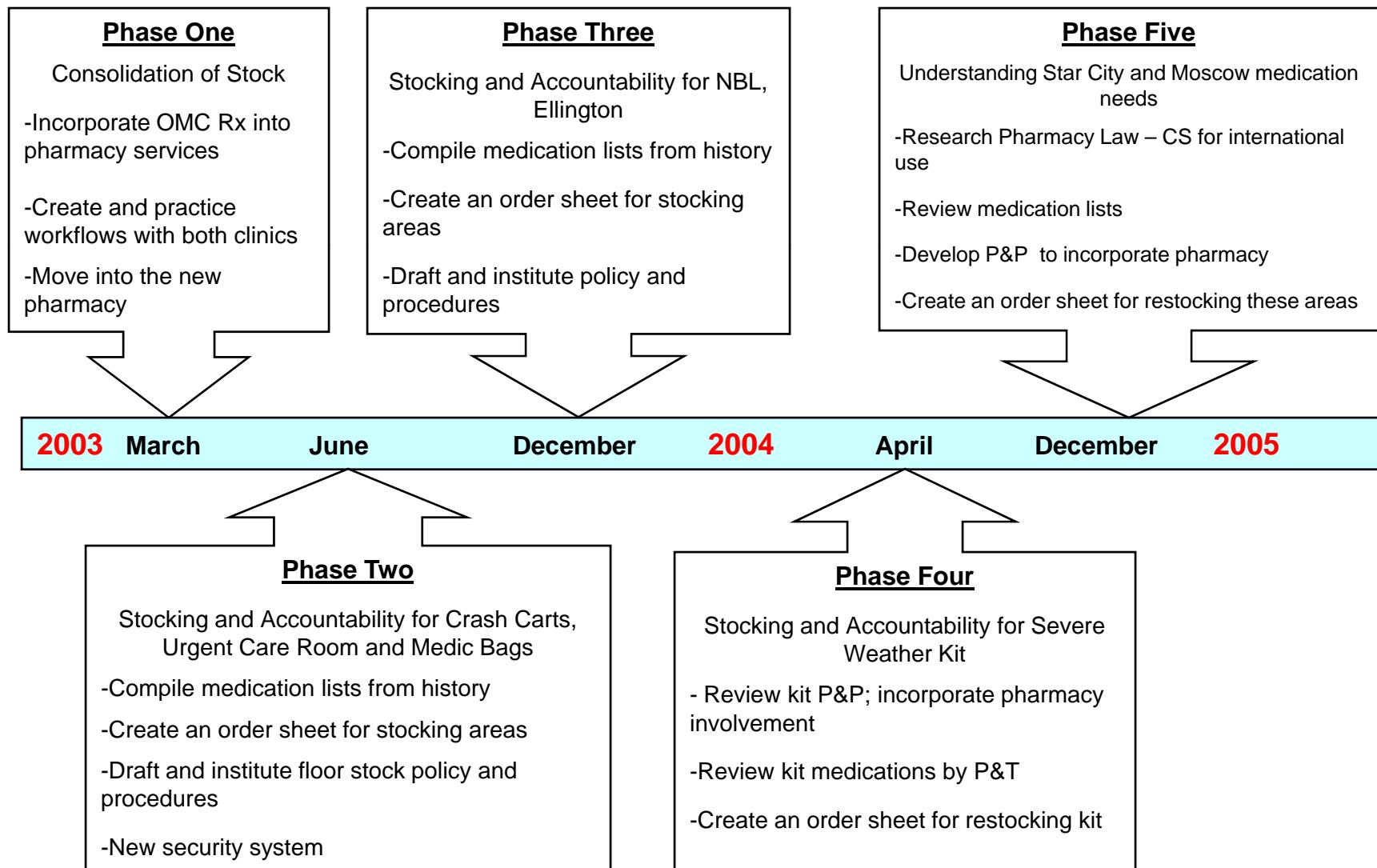


# The Plan – Terrestrially



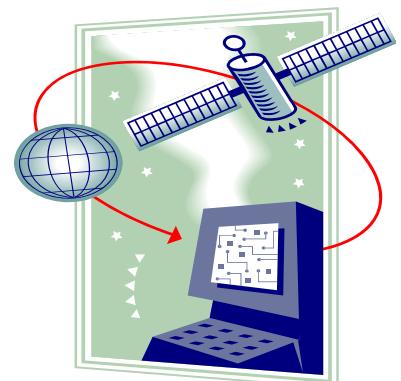
- Bring in an outside consultant to aid in preparations for Joint Commission readiness
- Implementation plan covering 24 –36 months
- Most of implementation plan is to fold in areas covered by the Occupational Medicine Clinic
- Implementation plan includes timelines for policy and procedure drafting

# Roadmap For Implementation



# First Things First

- Pharmacy Management System
  - Fill prescriptions with appropriate labeling
  - Maintain prescription history for patient medication recall system
  - Therapeutic monitoring
  - Inventory control
  - Patient education monographs for patient counseling
  - Maintenance of required records
  - Reporting



# First Things First

- Dispensing Medications
  - Every drug that leaves the pharmacy has a prescription/order attached to it for accountability
- Education
  - Counseling
  - Education to medical staff:
    - New policy & procedures
    - Changes to the formulary
    - Use of medical devices
    - Drug utilization reviews
    - Drug information questions



# First Things First



- Pharmacy & Therapeutics Committee Participation
  - Formulary management
  - Policy and procedure review
  - Medication management issues
  - Performance improvement

# First Things First



- Patient Safety and Increased Awareness
  - Our biggest challenge terrestrially
  - Bring the medications under pharmacy control
    - Management
    - Security
    - Storage
    - Educate area on policy and procedures
  - Many medication kits/areas uncovered
    - 35 kits (some obsolete)
    - Eye clinic
    - Dental clinic
    - Reduced Gravity Flight Program
    - Medical Operations/ Space Medicine



# An Evolution

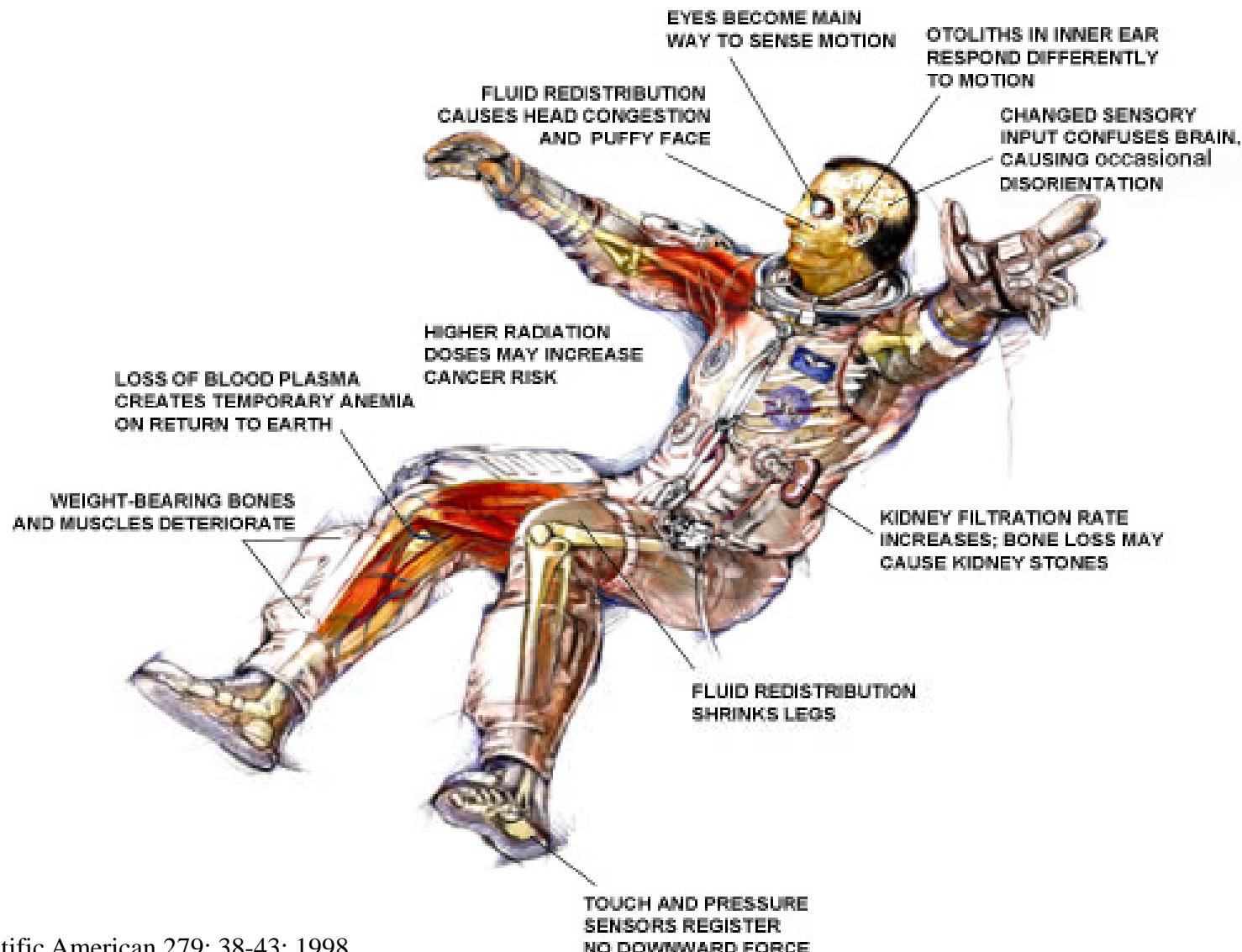
- Pharmacist Support in Space Medicine
  - 1999 – monographs
  - 2000 – packing medical kits
    - Shuttle Orbiter Medical Systems (SOMS)
    - International Space Station (ISS)
  - 2003 to present – Above plus
    - Clinical involvement
    - Medical checklist procedures
    - Drug tolerance testing
    - Med kit design
    - Regulatory guidance

# What is Space Medicine?

- Subdiscipline of Aerospace Medicine
- Branch of Preventive Medicine that deals with the clinical and preventive medical requirements of man in atmospheric flight and space
  - Physiologic Changes
  - Environmental conditions



# Effects of Space Travel on the Body



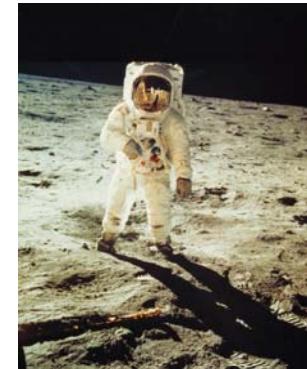
# Pharmacy in Space Medicine

- Pharmacy is complementary
- Pharmacological countermeasures used to combat physiologic changes
- Effects on environmental conditions to drugs
- Pharmaceutics issues
  - Fluid properties in zero G
- Drug delivery systems
- Interpretation of pharmacy law
- Application of patient safety standards



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# Pharmaceutical Care in Space Medicine



- Outcomes of space medicine pharmaceutical care are:
  - Elimination or reduction of a crewmember's symptomatology
  - Arresting or slowing of long term effects from microgravity – or –
  - Preventing long term effects or symptomatology as a result of microgravity
- Stakes are higher
  - Space medicine pharmaceutical care is about both the patient and the mission

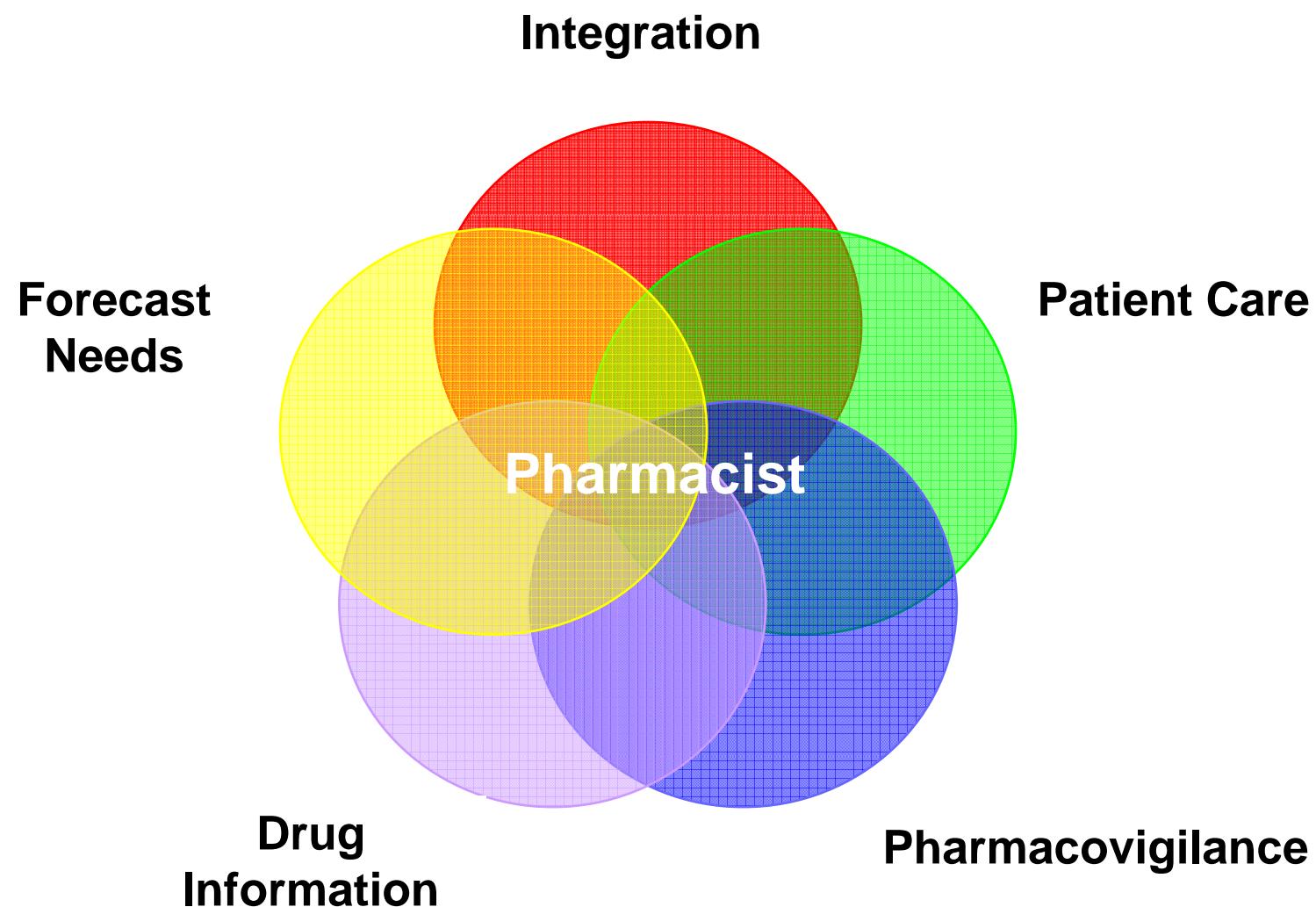
# Challenges

- Same General Challenges
  - Inserting medication management into existing engineering driven processes
  - Preconceived and misunderstood ideas of pharmacy responsibilities
  - Well-set behaviors
- Additional
  - Communication with non-medical disciplines
  - Benchmarks for processes may not exist
    - Regulatory/legal issues
  - How drugs work in microgravity
    - What we know and what we don't know

# Opportunities

- Continuous education of pharmacy responsibilities
- Increase visibility
- Representation in medical operations discussions
- Pharmacy knowledgebase asserted





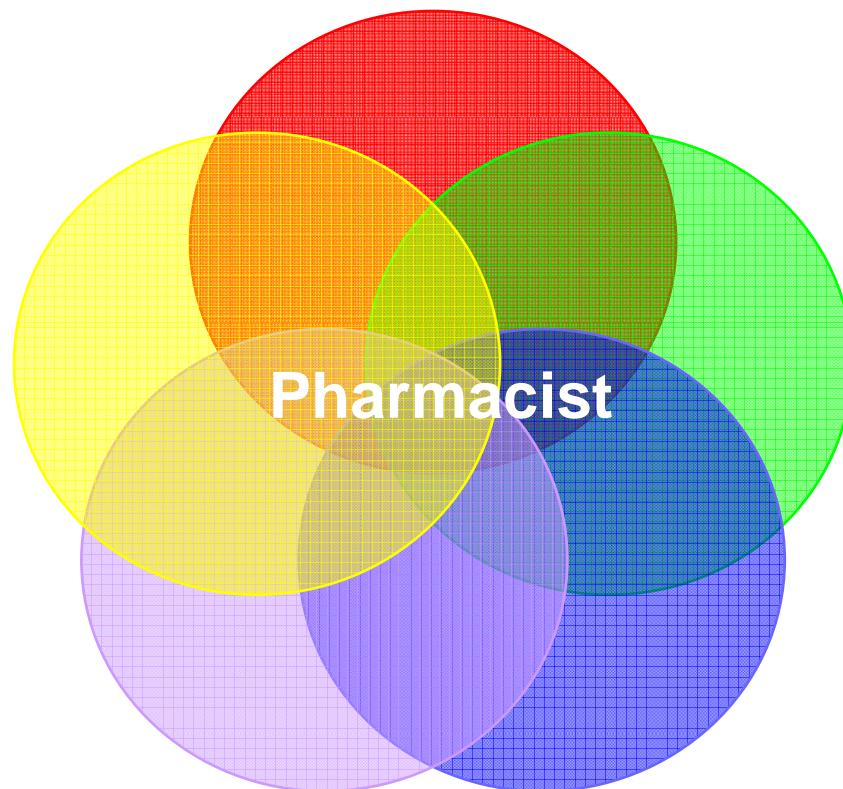
**Integration**

**Forecast  
Needs**

**Patient Care**

**Drug  
Information**

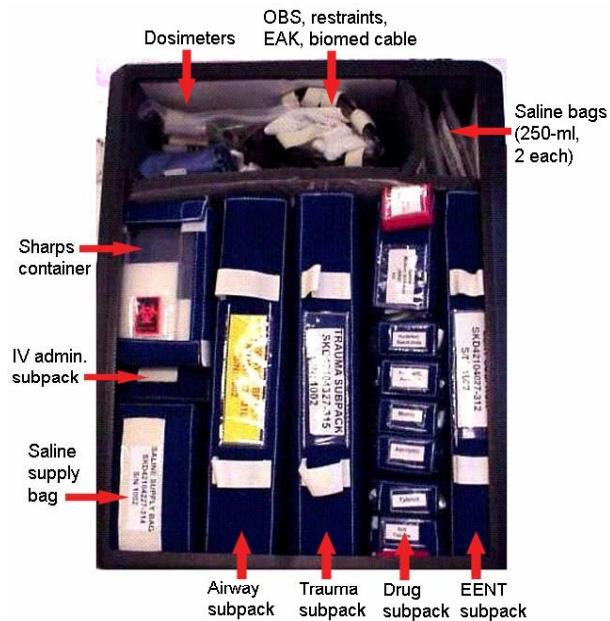
**Pharmacovigilance**



# Pharmacy Integration

- Team member pre-spaceflight
  - Physician, nurse, engineer, human factors, biomedical engineer, trainers and pharmacist
- Patient care
- Distinct perspective – medication management utilizing standards
  - Patient safety – critically evaluated
  - Drug information
    - Medication kit design
    - Selection of medications for the International Space Station and Space Shuttle medical kits

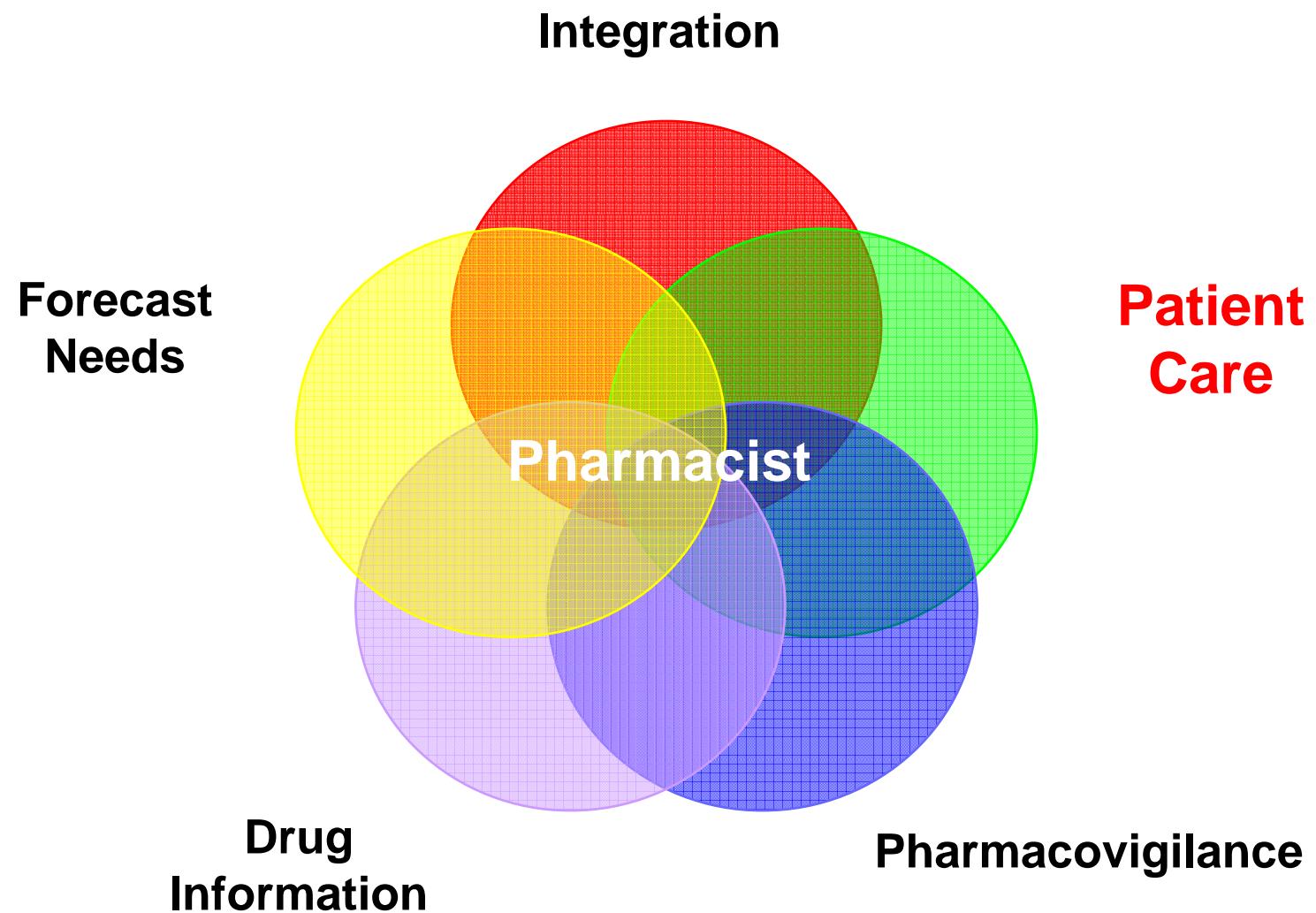
# On-Orbit Medication Kits



# Pharmacy Integration

- Team member during spaceflight
  - Physician, pharmacist and engineer
    - Patient safety issues
    - Drug information
    - Contingency support
- Team member post-flight
  - Physician, nurse and pharmacist
    - Earth Readaptation Syndrome
  - Research support
    - Patient safety issues
    - Drug information

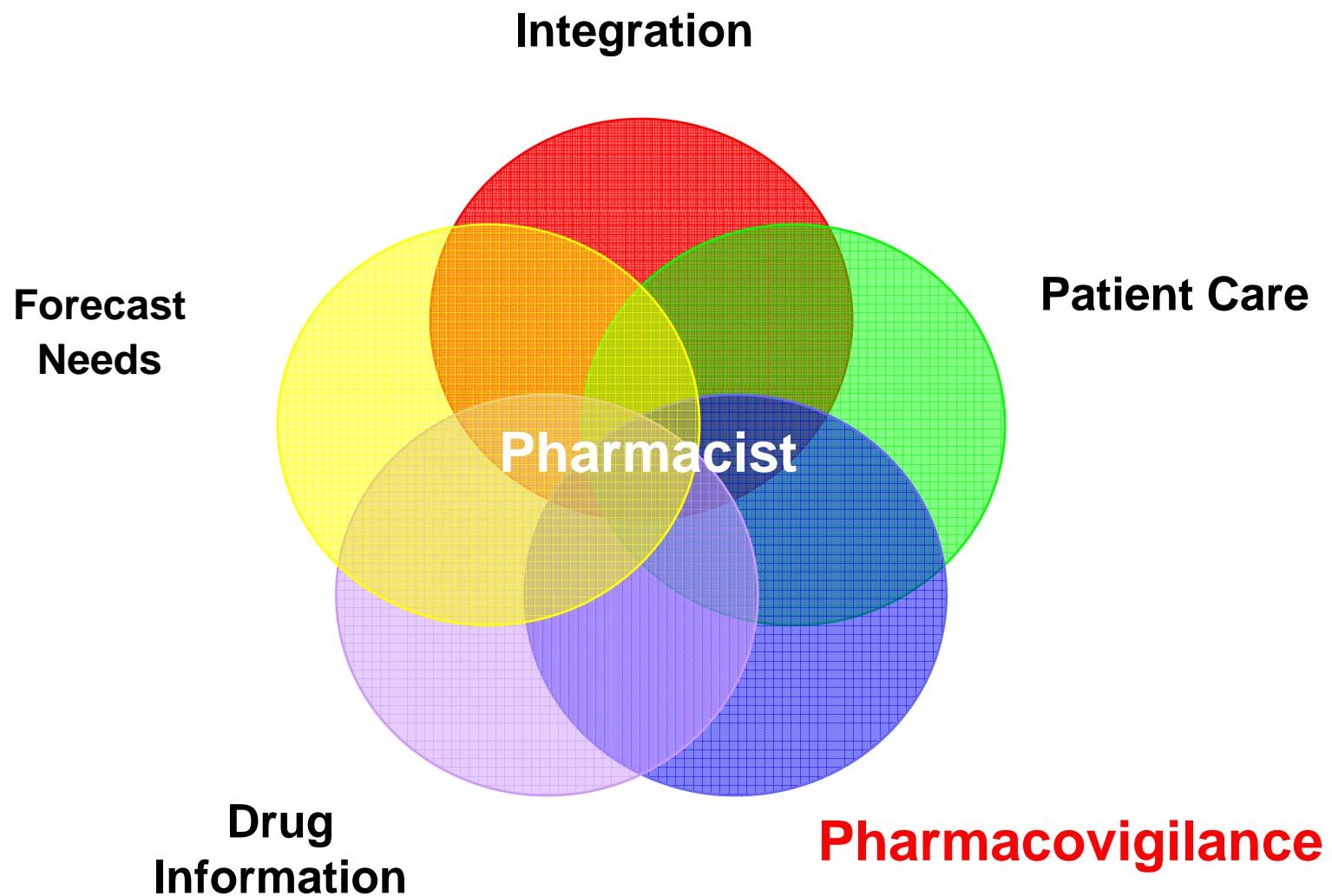




# Patient Care



- Terrestrial medication needs previously discussed
- Preventative care
  - Drug Tolerance Testing
  - Pharmacologic countermeasure support/identification
- Patient safety
  - Changes in dosage forms, delivery systems = training
- Drug utilization reviews
  - Possible pharmacokinetic and pharmacodynamic shift identification



# Pharmacovigilance in Space Medicine

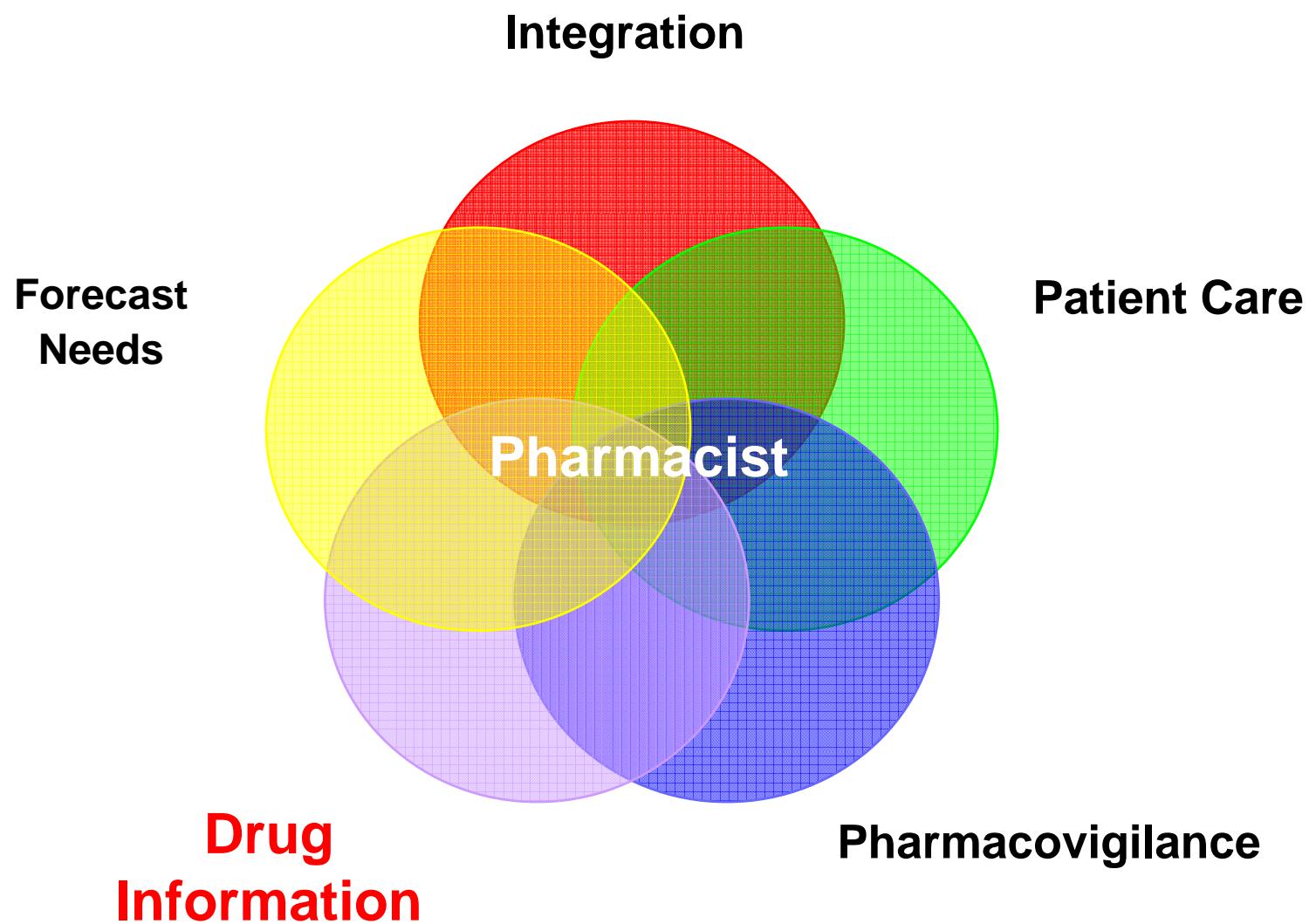
- Pharmacological science relating to the detection, assessment, understanding and prevention of adverse effects, particularly long term and short term side effect of medicines.
- Abnormal environment
  - identifying new information about hazards associated with medicines
  - preventing harm to crewmembers
- **Critical for space medicine as a preventative medicine**

# Pharmacovigilance



## Pharmacy's impact

- Pharmaceutics knowledge
  - Kit inspection
    - Visual alterations
  - Proper storage
    - Example, transdermal patch
- Patient safety
  - Drug Tolerance Testing
  - Dosing/administration alerts
  - Drug recalls
  - Sound alike/look alike
  - Drug-induced photosensitivity



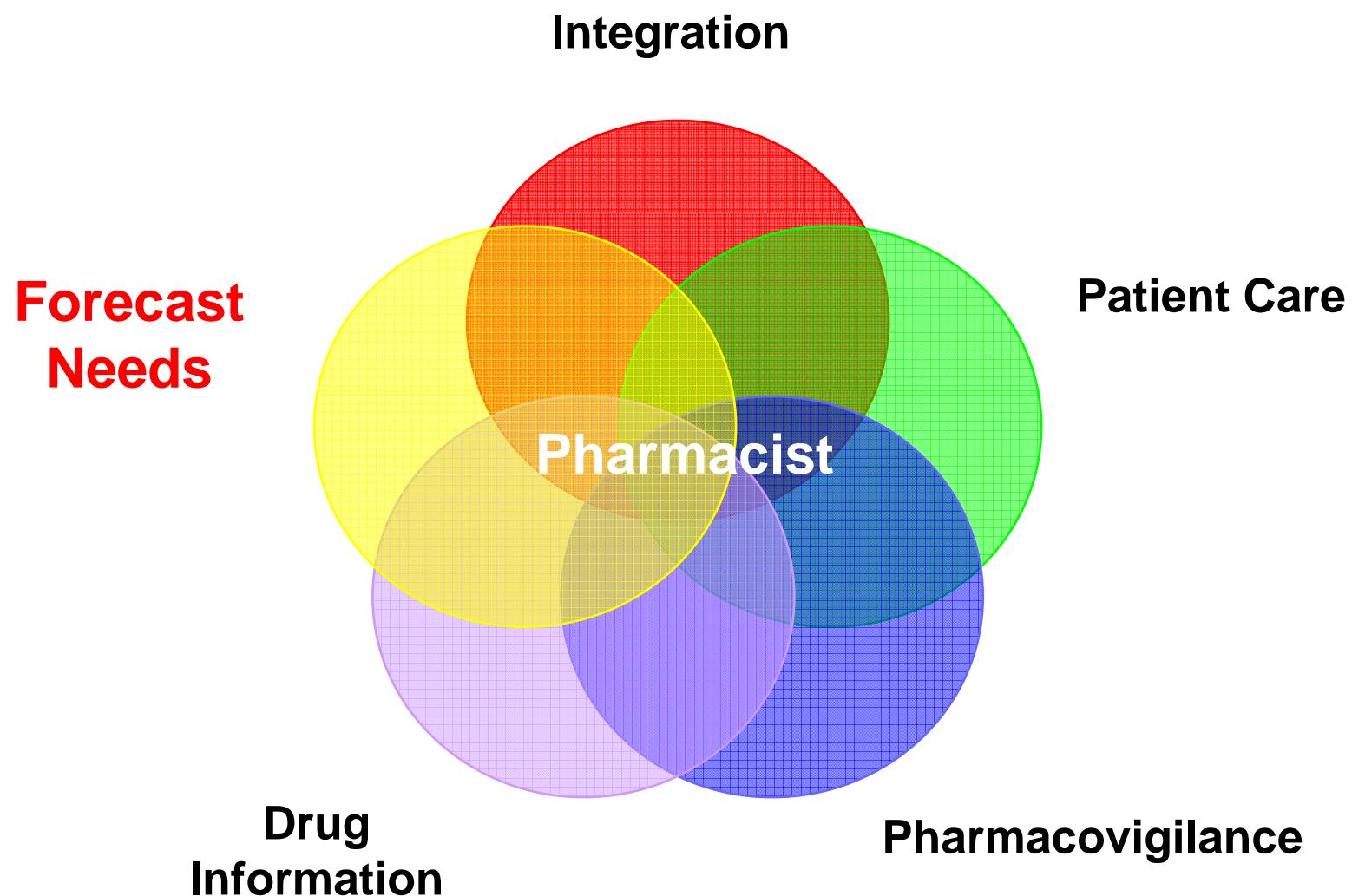


# Drug Information

- Space medicine – tailored information
- Pharmacist involvement in medical checklist procedures
  - Ensure medication information is accurate
- Medication monographs
  - Medication kit specific information
  - Include literature citations as relate to microgravity (dosing, stability)
  - Multi-national crew = multi-national medications

# Drug Information

- Pharmaceutical technology update
  - New drug delivery systems
  - Finding substitutes for obsolete systems
    - Closed/altered environment requires safety, materials, human factors reviews before can fly
- Pharmaceutical reformulation and/or withdrawal updates
  - Reformulation popular (e.g., Pseudoephedrine)
  - Increase in drug withdrawals, restrictions



# Forecast Need

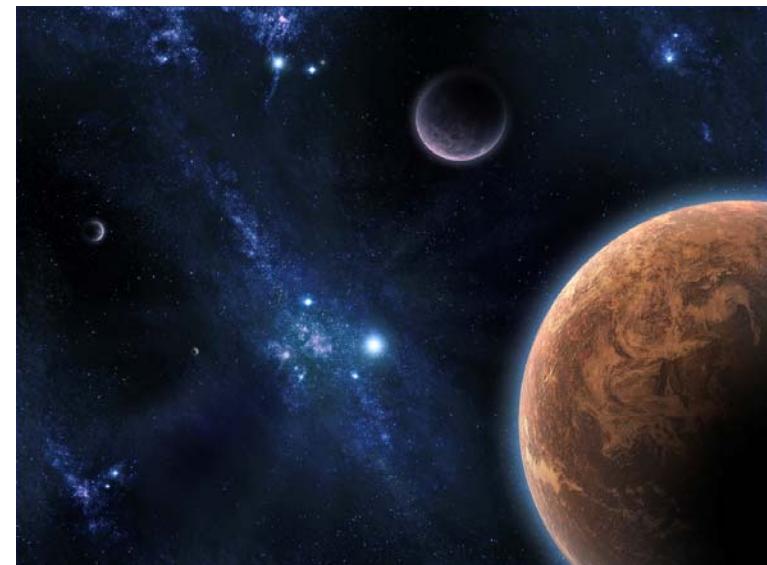
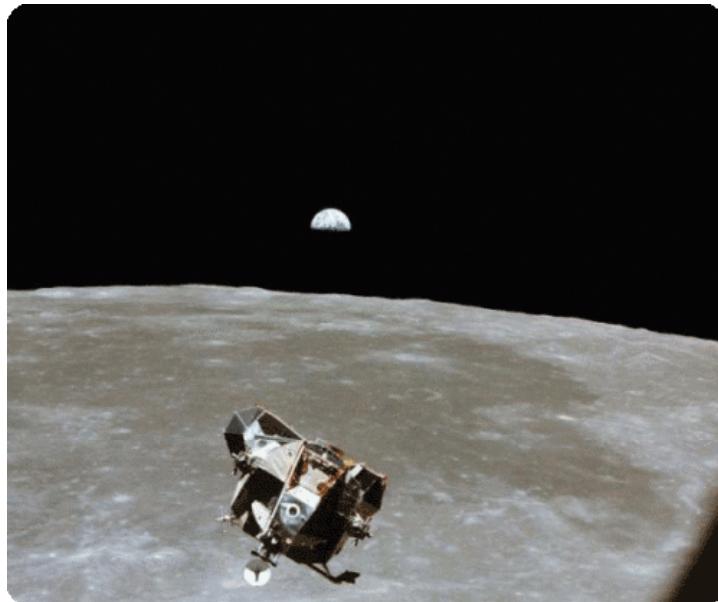
- New clinical services branch
  - Services collated
  - Increased committee work
- Increased involvement in the medical kit packing
- Constellation program



# Forecast Need

## Missions to the Moon and Mars

- Pharmacokinetic and pharmacodynamic research
- Better dosage forms (less mass/volume)
  - Less physical space for medical equipment
- Stability information for medications
  - Missions will be longer than six months with no resupply option



# Summary



- In five years:
  - NASA has seen creation of a physical pharmacy
  - NASA has benefited from pharmacist's expertise with improvements in medication management both in terrestrial medicine and space medicine
  - JSC Pharmacy has become prepared to support NASA into the next frontier

# **Self-Assessment Questions:**

## **(True or False)**

- A pharmacist has made significant contributions to the United States Space Program. (True)
- Patient safety standards can only be applied to terrestrial-based medication management. (False)
- Pharmacy regulations do not apply to space medicine. (False)